



ISSUE 1: JUNE 2007

SLOWER CAN BE BETTER

The ULTRA-SET Advantage is here! Mt. Savage shotcrete materials consistently out perform competitors materials in a variety of applications. This is largely due to the activator that is used. Most activators react too fast to let the castable densify, ULTRA-SET gives the castable enough time to fill out.

THE ULTRA-SET ADVANTAGE page 4

THERMAL SHOCK CAN RUIN YOUR DAY

Having a bad day? Imagine if you had to be cycled from 2200°F to a bucket of water on a continuous basis until you broke in two. That is the life of a refractory test piece in a refractory laboratory. Many applications see severe thermal cycling damage. Find out what the parameters for thermal cycling are and how to reduce or even eliminate this damage.

THERMAL SHOCK page 2



The low dust and rebounds result from the Ultra-Set advantage

Use of ULTRA-SET improves strength up to 50% over use of a soluble salt activator.

Low Cement Products tend to have much better thermal shock resistance than conventional castables.

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THE BUZZ IS HERE!



Shotcrete is being commonly used in lime and aggregate kilns

So, what is the Buzz all about? Well, it seems a lot of people lately are talking about Mt. Savage Specialty Refractories. From Cement Plants to Steel Mills, the quality, consistency, and service of Mt. Savage Specialty Refractories materials and people are beginning to get noticed. People are starting to ask what is all the buzz about?

Simply put, Mt. Savage Specialty is in a unique position to offer a very complete line of brick and specialty products with out the red tape and confusion often associated with the larger refractory companies. Mt. Savage will put its quality, performance, and service up to any of the big boys all at a competitive price. You need fast delivery? You need good product recommendations? You need consistent quality, or predictable and reliable properties? Mt. Savage Specialty should be your refractory company.

For more on Mt. Savage Specialty, check out our web site.

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Questions or comments? E-mail us at info@mtsavage.com or call us at 1-800-437-6777.

THERMAL SHOCK

Thermal shock is caused by the rapid change of temperature of a solid body. All products see some kind of thermal fatigue caused by rapid temperature change, but some products are much more prone to damage than others. This little article is meant to teach the basics of what thermal shock is in a refractory body, what causes the damage, and how can the damage of fast temperature change be avoided or at least minimized.

Ceramics, as you know, are brittle materials. Glass is a perfect example of something that is brittle. A perfect glass fiber can be 10 times as strong as a steel fiber, yet hit a glass with the same composition with a hammer, it breaks. Thermal shock damage in refractories is related to this brittle behavior of ceramics.

What causes the stresses in changing temperatures is the differential expansion of the material because of temperature differences in the lining. Imagine a refractory wall that is heated rapidly to 2700°F. The interior of the wall is much cooler than the hot face which means the hot face will have expanded more than the interior. This causes shear stress between the hot face and the interior, and if the stress is high enough, failure, or cracking can occur. Often, cracking can relieve stress and is not necessarily a bad thing, more on that later.

The real damage, however, occurs when the hot face is rapidly cooled, causing the hot face to shrink more than the interior. Why is this worse than rapid heat up? When the hot face is trying to shrink more than the interior, the interior is holding the hot face from doing so, putting the hot face in tension. Conversely, rapid heating puts the hot face in compression. Ceramics are much weaker in tension than they are in compression, thus it takes less of a temperature change cooling to cause damage than when heating.

How does one avoid damage due to thermal shock? The obvious is to heat and cool gradually allowing the ceramic to adjust. We all know this is not the real world, so how do we design our product choice around thermal shock situations? The first is to make the ceramic body non-continuous. High cement products have a tendency to act like a glass in the matrix of a castable, promoting continuous cracking. Low cement products, however, are more broken up with energy having to go between grains and grain to grain. This tends to dissipate any crack that is initiated. This is why low cement products will have better thermal shock resistance than high cement products of the same alumina content.

Another way to dissipate a crack caused by thermal shock is adding steel fibers to the material. Since steel is flexible, a crack has to go around it to continue on. This has a tendency to stop the crack. Other ways to dissipate crack energy is to add a product with a very different thermal expansion characteristic than the main body. Zirconia is one example. What that does is cause a crack to form right around the zirconia addition, and when a crack caused by thermal shock hits that area, it has to go all the way around the zirconia grain. Again, this tends to stop the crack from propagating.

As we mentioned earlier, the stress is caused by the interior and exterior expanding at different rates because of a temperature difference between the two. This gives us two more ways to attack thermal shock. One is to use a product that has very low thermal expansion. Obviously, if a product had no thermal expansion, a temperature difference would not cause any stress at all. Fused silica is the ceramic that comes closest to zero expansion over a wide temperature range, and thus has the best thermal shock resistance of any commonly used refractory aggregate. Fused silica, unfortunately, starts to convert to crystalline silica at about 2100°F and loses its thermal expansion advantage. Products us-

ing fused silica plus low cement technology such as ULTRA-TEK FS, however, have outstanding thermal shock resistance below the conversion temperature.

Another way to fool Mother Nature is to minimize the temperature difference between the interior and exterior. This can be accomplished by using materials with very high thermal conductivities, such as silicon carbide. Obviously, if there is no temperature difference between the interior and exterior, there would be no thermal stress. High conductivity minimizes the temperature difference thus minimizing the stress. Silicon carbide has the added benefit of having low thermal expansion, giving it two advantages over most ceramic materials.

To summarize, thermal shock damage is caused by temperature swings that cause the interior and exterior to expand at different rates. This damage can be minimized by going to non-glassy bonding systems such as low cements versus higher cements. Additives such as steel fibers or zirconia can be added to limit crack propagation. Using aggregate with low thermal expansion, such as fused silica, further reduces the tendency to damage. High thermal conductivity, such as silicon carbide also reduces stresses.

For more information concerning your refractory questions, contact your local Mt. Savage Representative or call the main office at 412-367-9100.

LOW CEMENT GUN MIXES

As the previous article indicates, one way to reduce thermal shock damage in a castable is to go to a low cement system. This is true in gunning mixes as well. Mt. Savage offers a wide variety of low cement gunning mixes that gun as well, or better than most conventional gunning mixes. These mixes were designed to be gunned without predampening. In fact, the properties of these **ULTRA-TEK GUN MIXES** will be slightly better without predampening! The reason for this is that these mixes are based on shotcrete technology, with an additive that will quickly turn what would be a mix that wants to flow like a castable, into a sticky gunning mix. When you don't predampen, this reaction takes a half a second or so to occur, allowing the mix to densify on the wall slightly more than when you do predampen.

To maximize properties and to minimize dust and rebounds, the Buzz tip of the day is spend your money on a water booster pump. This is true whether you are shooting **ULTRA-TEK** low cement mixes, a quality conventional mix like a **HEATCRETE**, and becomes even more important when shooting something from one of those other guys. High water pressure allows material to be properly and evenly wetted in the nozzle making the job of the nozzle man much easier. The price of a water pump is certainly less than the price of a predampening unit, just remember to drain it in the winter (they don't like ice).



Test Samples just having a bad day

THE ULTRA-SET ADVANTAGE

Time after time, side by side comparisons of Mt. Savage made shotcrete mixes look better than their competitors. This is true in hot metal cars, cement coolers and pre-heaters, aluminum furnaces, and power stations. The main (but not only) reason for this is the ULTRA-SET advantage.

ULTRA-SET is the activator used at the nozzle to keep the material from slumping off of the wall when it is applied. It differs from most other activators used in that it is a suspension rather than a solution. A solution has some advantages over a suspension in that it is somewhat easier to set up, but the advantages of ULTRA-SET far out weigh the disadvantages.

The first and most important advantage is better properties. Because ULTRA-SET takes a second or two to work, the material can literally be cast into place and still has some flow to it, allowing the material to densify in place. Solutions react much faster, turning a castable basically into a gunning mix before it hits the wall. Competitors usually recommend high air pressures to densify the material while Mt. Savage recommends just enough air to get the material to the target, let the castable densify itself.

The next advantage of ULTRA-SET is that it also accelerates the set of a castable, unlike most solution activators. Thus, competitors must build the setting behavior into the castable, lowering working time. Mt. Savage builds a minimum of 4 hours working time (at 70°F) into their castables, allowing time for lunch breaks or equipment repairs. This takes a lot of pressure off of the installer, particularly in hot weather.

A third advantage is cost. ULTRA-SET is so inexpensive that Mt. Savage supplies it free of charge with its shotcrete mixes. Make sure you add the cost of the activator when figuring a job; that is easy with ULTRA-SET!



Installation rates in a rotary kiln are high for ULTRA-TEK products as obstructions are minimal. The ULTRA-SET advantage allows the operator to turn the kiln much faster than with competitive activators, as ULTRA-SET actually sets the material hard in one to two hours!

Rebounds, though low in all shotcrete mixes, are further reduced with ULTRA-SET because of the lower air pressures used and the delayed stiffening action.

Mt. Savage averages over 1,000 tons of shotcrete materials shipped each month. We believe this success is based largely on the ULTRA-SET advantage combined with the consistent quality of our pumpable products. We understand that a shotcrete installation is only as easy as the hardest bag is to pump and thus we make no bags hard to pump. A contractor who had not previously used Mt. Savage shotcrete before recently commented on a Mt. Savage installation, "This can't be a shotcrete job, nobody is throwing their hardhat or kicking the equipment, am I in the right place?" Using Mt. Savage materials, I told him, you are definitely in the right place.

IEEE Breakfast a Big Success

The Mt. Savage Specialty Refractory Company sponsored a breakfast for attendees at this year's IEEE Cement Conference in Charleston, South Carolina. This breakfast was available to everyone that attended the plant tours on the last day of the conference. Over 250 meals were handed out to attendees. As it is difficult to determine how many people were going to take advantage of this situation, an additional 150 meals or so were donated to the Charleston food bank. All in all, there were a lot of well fed people!



CEMENT KILN SUCCESS

Cement kiln preheaters are an excellent place to take advantage of the ULTRA-SET advantage. Shooting up to 250 foot in the air, Mt. Savage has not had one installation delay due to ability to pump ULTRA-TEK products since starting to service the cement industry. This represents over 5,000 bulk sacks of materials in the last 2 years alone. The increased density obtained from using ULTRA-SET, keeps the customers coming back for more, year after year! The tower pictured here is Lehigh Cement, Union Bridge, where Mt. Savage has supplied over 600 tons of material in the last two years. If your installation is less than 250 feet in the air, imagine how easy that will make it!